(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 015 756**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 80300693.1

(22) Date of filing: 06.03.80

(51) Int. Cl.³: C 07 D 249/08, A 01 N 43/64
// (C07D303/28, C07C31/34, 29/40)

(30) Priority: 07.03.79 GB 7908003
21.09.79 GB 7932819

(43) Date of publication of application: 17.09.80
Bulletin 80/19

(84) Designated Contracting States: BE CH DE FR GB IT NL

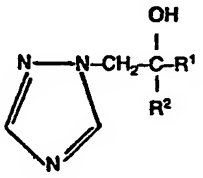
(71) Applicant: IMPERIAL CHEMICAL INDUSTRIES LIMITED, Imperial Chemical House Millbank, London SW1P 3JF (GB)

(72) Inventor: Parry, Keith Peter, 10, Calder Court, Maidenhead Berkshire (GB)
Inventor: Worthington, Paul Anthony, 22, Boulters Gardens, Maidenhead Berkshire (GB)
Inventor: Rathmell, William George, 'Culvers' 10, Gypsy Lane, Wokingham Berkshire (GB)

(74) Representative: Fawcett, Richard Fennelly et al, Imperial Chemical Industries Limited Legal Department: Patents Thames House North Millbank, London SW1P 4QG (GB)

(54) **Triazole compounds, a process for preparing them, their use as plant fungicides and fungicidal compositions containing them.**

(57) Compounds of formula:



wherein R^1 is alkyl, cycloalkyl or phenyl and R^2 is phenyl or benzyl and their acid addition salts and metal complexes. The compounds have fungicidal activity.

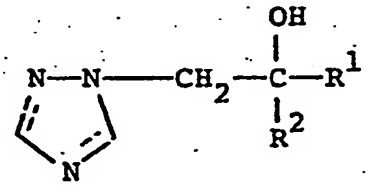
EP 0 015 756 A1

3069e/EP

TRIAZOLE COMPOUNDS, A PROCESS FOR PREPARING THEM, THEIR USE AS PLANT FUNGICIDES AND FUNGICIDAL COMPOSITIONS CONTAINING THEM

This invention relates to triazole compounds useful as fungicides, to a process for preparing them, to fungicidal compositions containing them, and to a method of combating fungal infections in plants using them.

The triazole compounds have the general formula (I):



wherein R^1 is alkyl, cycloalkyl (e.g. cyclopentyl or cyclohexyl) or optionally substituted phenyl and R^2 is optionally substituted phenyl or optionally substituted benzyl; or an acid addition salt or metal complex thereof.

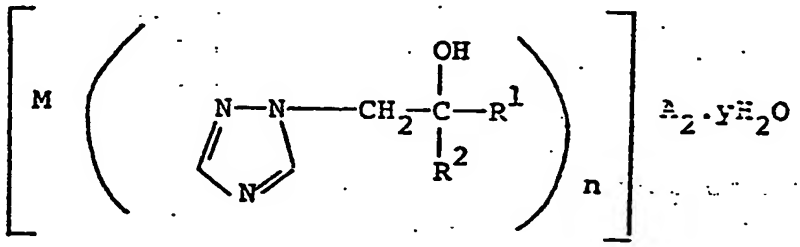
The compounds of the invention can contain chiral centres. Such compounds are generally obtained in the form of racemic mixtures. However, these and other mixtures can be separated into the individual isomers by methods known in the art.

The alkyl groups can be a straight or branched chain group having 1 to 6, e.g. 1 to 4, carbon atoms; examples are methyl, ethyl, propyl (n- or iso-propyl) and butyl (n-, sec-, iso- or t-butyl).

Examples of suitable substituents for the phenyl and for the phenyl moiety of the benzyl are halogen (e.g. fluorine, chlorine or bromine), C_{1-5} alkyl [e.g. methyl, ethyl, propyl (n- or iso-propyl) and butyl (n-, sec-, iso- or t-butyl)], C_{1-4} alkoxy (e.g. methoxy and ethoxy), trifluoromethyl, nitro, phenyl and phenoxy. The alkyl moiety of the benzyl can be substituted with for example one alkyl (e.g. methyl or ethyl). Suitably the phenyl and benzyl are unsubstituted or substituted with 1, 2 or 3 ring substituents as defined above. Preferably the benzyl and phenyl have a single ring substituent in the O-position. Examples of these groups are phenyl, benzyl, α-methylbenzyl, o-, m- or p-chlorophenyl, 2,4- or 2,6-dichlorophenyl, o-, m- or p-fluorophenyl, 2,6-difluorophenyl, o-, m- or p-bromophenyl, 2-chloro-4-fluorophenyl, 2-chloro-6-fluorophenyl, o-, m- or p-methoxyphenyl, 2,4-dimethoxyphenyl, o-, m- or p-ethoxyphenyl, o-, m- or p-nitrophenyl, o-, m- or p-methylphenyl, o-, m- or p-t-butylphenyl, o-, m- or p-trifluoromethylphenyl, o-, m- or p-phenoxyphenyl, and o-, m- or p-phenylphenyl (o-, m- or p-biphenylyl), and the corresponding ring substituted benzyl and α-methylbenzyl groups.

The salts can be salts with inorganic or organic acids e.g. hydrochloric, nitric, sulphuric, acetic, p-toluenesulphonic or oxalic acid.

Suitably the metal complex is one including, as the metal, copper, zinc, manganese or iron. It preferably has the general formula:



wherein Y, R^1 and R^2 are as defined above, M is a metal, A is an anion (e.g. a chloride, bromide, iodide, nitrate,

sulphate or phosphate anion), n is 2 or 4 and y is 0 or an integer of 1 to 12.

Examples of the compounds of the invention are shown in Table I.

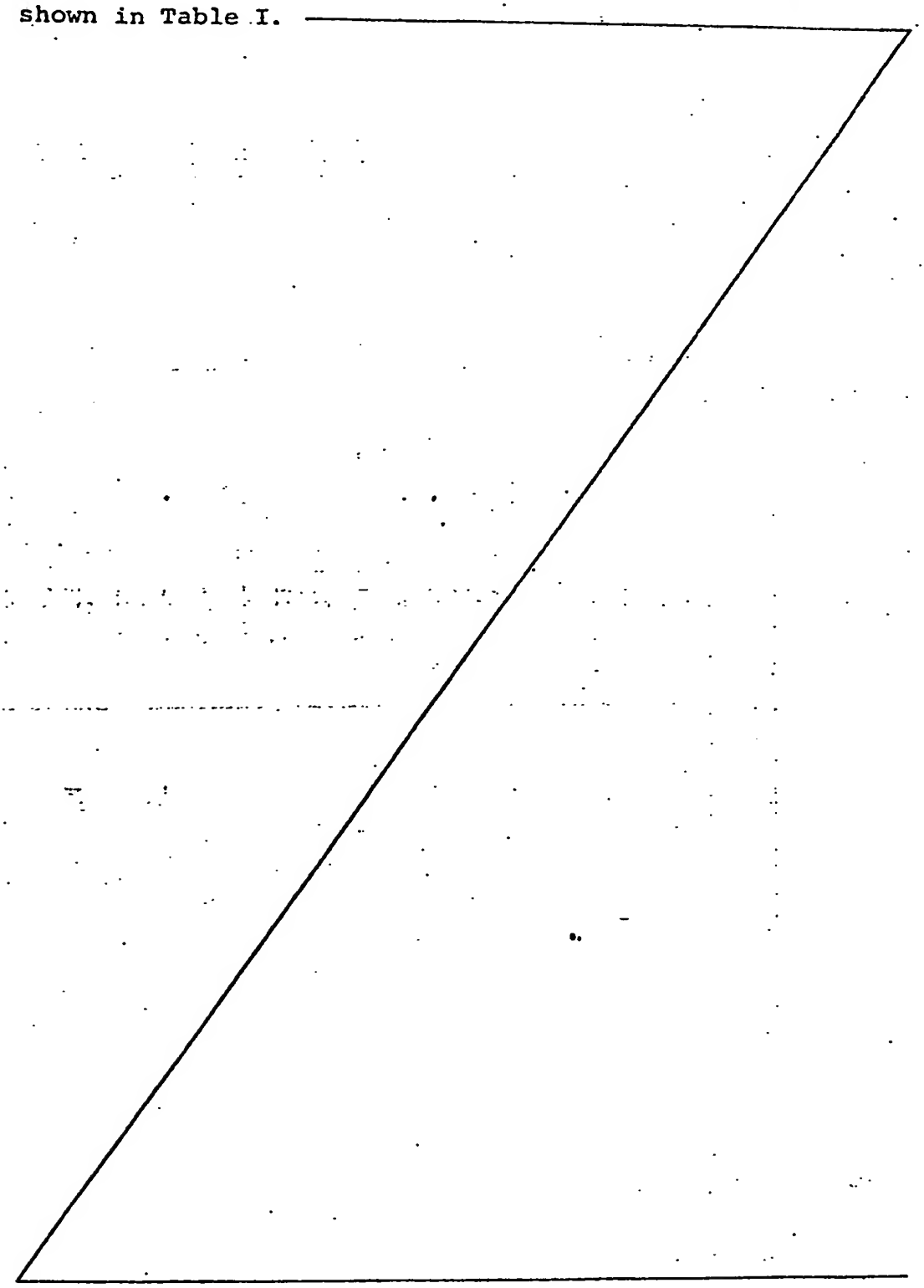


TABLE I

COMPOUND NO	R^1	R^2	MELTING POINT (^oC)
1	C_6H_5-	$C_6H_5CH_2$-	124-125
2	C_6H_5-	p-Cl-$C_6H_4CH_2$-	144-145
3	C_6H_5-	p-F-$C_6H_4CH_2$-	116-118
4	p-Cl-C_6H_4-	p-Cl-$C_6H_4CH_2$-	80-83
5	p-Cl-C_6H_4-	$C_6H_5CH_2$-	109-111
6	p-F-C_6H_4-	$C_6H_5CH_2$-	141-142
7*	C_6H_5-	2,4-diCl-$C_6H_3CH_2$-	104-106
8+	p-F-C_6H_4-	p-F-$C_6H_4CH_2$-	154-156
9	p-F-C_6H_4-	p-Cl-$C_6H_4CH_2$-	168-170
10	t-Bu	$C_6H_5CH_2$-	110-110
11	t-Bu	p-Cl-$C_6H_4CH_2$	86-87
12	t-Bu	p-F-$C_6H_4CH_2$-	146-148
13	C_6H_5-	o-F-$C_6H_4CH_2$-	133-134
14	p-Cl-C_6H_4-	o-F-$C_6H_4CH_2$-	95-96
15	C_6H_5-	o-Cl-$C_6H_4CH_2$	69-71
16	p-MeO-C_6H_4-	$C_6H_5CH_2$	100-103
17	C_6H_5-	C_6H_5-	128-129
18+	p-F-C_6H_4-	p-F-$C_6H_4CH_2$-	161-163
19	C_6H_5-	2,4-diCl-$C_6H_3CH_2$-	104-106

TABLE I CONTINUED...

COMPOUND NO	R^1	R^2	MELTING POINT (^oC)
20	t-Bu	o-Cl-$C_6H_4CH_2$-	74-75
21	t-Bu	o-F-$C_6H_4CH_2$-	96-98
22	t-Bu	m-Cl-$C_6H_4CH_2$-	88-89
23	t-Bu	m-CF_3-$C_6H_4CH_2$-	106-107
24	C_6H_5-	p-t-Bu-$C_6H_4CH_2$-	80-83
25	p-Cl-C_6H_4-	C_6H_5-	83-85
26	p-Cl-C_6H_4-	p-Cl-C_6H_4-	147-148
27	p-Cl-C_6H_4-	p-F-C_6H_4-	154-155
28	2,4-diCl-C_6H_3-	C_6H_5-	191-194
29	p-F-C_6H_4-	p-F-C_6H_4-	170-171
30	p-F-C_6H_4-	C_6H_5-	139-140
31	i-Bu	C_6H_5-	94-95
32	n-Bu	p-Cl-C_6H_5-	95-97
33	t-Bu	2-Cl-6-F-$C_6H_3CH_2$-	
34	t-Bu	2-Cl-4-F-$C_6H_3CH_2$-	
35	t-Bu	2-F-4-Cl-$C_6H_3CH_2$-	
36	t-Bu	2,4-diCl-$C_6H_3CH_2$-	
37	t-Bu	2,6-diCl-$C_6H_3CH_2$-	
38	t-Bu	2,6-diF-$C_6H_3CH_2$-	

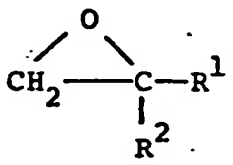
TABLE I CONTINUED...

COMPOUND NO	R^1	R^2	MELTING POINT (^oC)
40	C_6H_5-	p-t-Bu-C_6H_4	
41	C_6H_5-	o-Cl-C_6H_4-	
42	C_6H_5-	o-F-C_6H_4-	
43	p-Cl-C_6H_4-	o-Cl-C_6H_4-	137-138°
44	p-Cl-C_6H_4-	o-F-C_6H_4-	144-145°
45	p-F-C_6H_4-	o-Cl-C_6H_4-	115-116°
46	p-F-C_6H_4-	o-F-C_6H_4-	120-123°
47	C_6H_5-	o-C_6H_5-C_6H_4-	
48	p-Cl-C_6H_4-	o-C_6H_5-C_6H_4-	
49	C_6H_5-	o-C_6H_5O-C_6H_4-	
50	p-Cl-C_6H_4-	o-C_6H_5O-C_6H_4-	
51	C_6H_5-	o-Me-C_6H_4-	
52	p-Cl-C_6H_4-	o-Me-C_6H_4-	
53	2,4-diCl-C_6H_3-	p-F-C_6H_4-	137-138°

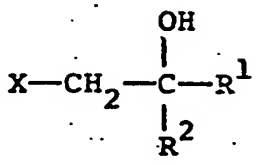
* Includes 1 mole of ethanol occluded in the crystal lattice

\+ Compounds 8 and 18 were obtained as polymorphs and this explains their different methy points

The compounds of general formula (I) may be produced by reacting a compound of general formula (II) or (III):



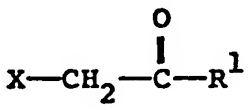
(II)



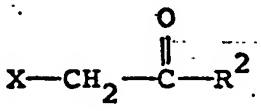
(III)

in which R^1 and R^2 are as defined above and X is a halogen atom (preferably a chlorine or bromine atom), with 1,2,4-triazole either in the presence of an acid-binding agent or in the form of one of its alkali metal salts in a convenient solvent. Suitably the compound of general formula (II) or (III) is reacted at 20-100°C with the sodium salt of 1,2,4-triazole (the salt can be prepared by adding either sodium hydride or sodium methoxide to 1,2,4-triazole) in a convenient solvent such as acetonitrile, methanol, ethanol or dimethylformamide. The product can be isolated by pouring the reaction mixture into water and recrystallising the solid formed from a convenient solvent.

The compounds of general formula (II) and (III) can be prepared by reacting a compound of general formula (IVa) or (IVb):



(IVa)



(IVb)

wherein R^1, R^2 and X are as defined above with, respectively, a Grignard compound of general formula (Va) or (Vb):

$Y—Mg—R^1$ (Va) $Y—Mg—R^2$ (Vb)

wherein R^1 and R^2 are as defined above and Y is a halogen (preferably chlorine, bromine or iodine) in a convenient solvent such as diethyl ether or tetrahydrofuran. Generally a mixture of the compounds of general formula (II) and (III) are obtained. For example, when a compound of general formula (IVa) wherein R^1 is alkyl or cycloalkyl is reacted, the compound of formula (II) generally predominates in the mixture; on the other hand, when R^1 is optionally substituted phenyl, the compound of general formula (III) generally predominates in the mixture.

The compounds of general formula (IV) and (V) may be made by methods set out in the literature.

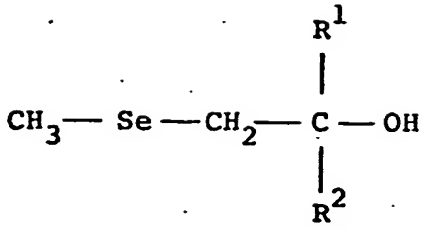
The compounds of general formula (II) wherein each of R^1 and R^2, which may be the same or different, is substituted phenyl may also be prepared by reacting the appropriate benzophenone compound of general formula (VI)

R^1-CO-R^2

wherein R^1 and R^2 are as defined above, with dimethyl oxosulphonium methylide (Corey and Chaykovsky, JACS, 1965, 87, 1353-1364) or dimethyl sulphonium methylide (Corey and Chaykovsky, JACS, 1962, 84, 3782) using methods set out in the literature.

The benzophenone compounds of general formula (VI) can be prepared, using the Friedel-Crafts reaction, by reacting a substituted benzoyl chloride with the appropriately substituted benzene in the presence of a Lewis acid e.g. aluminium chloride.

The compounds of general formula (II) wherein each of R^1 is alkyl, cycloalkyl or optionally substituted phenyl and R^2 is optionally substituted phenyl or optionally substituted benzyl can also be produced by reacting a β-hydroxy selenide compound of general formula (VII)



(VII)

wherein R^1 and R^2 are as defined above, with methyl iodide in potassium t-butoxide according to the method of Van Ende, Dumont and Krief, Angew. Chem. Int. Ed., 1975, 14, 700.

The β-hydroxy selenide compound can be prepared by treating the diselenide with the appropriate ketone in the presence of butyl lithium.

The salts and metal complexes of the compounds of general formula (I) can be prepared from the latter in known manner. For example, the complexes can be made by reacting the uncomplexed compound with a metal salt in a suitable solvent.

The compounds, salts and metal complexes are active fungicides, particularly against the diseases:-

Piricularia oryzae on rice

Puccinia recondita, Puccinia striiformis and other rusts on wheat, Puccinia hordei, Puccinia striiformis and other rusts on barley, and rusts on other hosts e.g. coffee, apples, vegetables and ornamental plants

Plasmopara viticola on vines

Erysiphe graminis (powdery mildew) on barley and wheat and other powdery mildews on various hosts such as Sphaerotheca fuliginea on cucurbits (e.g. cucumber), Podosphaera leucotricha on apples and Uncinula necator on vines

Helminthosporium spp. and Rhynchosporium spp. on cereals

Cercospora arachidicola on peanuts and other Cercospora species on for example sugar beet, bananas and soya beans
Botrytis cinerea (grey mould) on tomatoes, strawberries, vines and other hosts
Phytophthora infestans (late blight) on tomatoes
Venturia inaequalis (scab) on apples

Some of the compounds have also shown a broad range of activities against fungi in vitro. They have activity against various post-harvest diseases on fruit (e.g. Penicillium digatatum and italicum on oranges and Gloeósporium musarum on bananas). Further some of the compounds are active as seed dressings against: Fusarium spp., Septoria spp., Tilletia spp. (i.e. bunt, a seed borne disease of wheat), Ustilago spp., Helminthosporium spp. on cereals, Rhizoctonia solani on cotton and Corticium sasakii on rice.

The compounds can move acropetally in the plant tissue. Moreover, the compounds can be volatile enough to be active in the vapour phase against fungi on the plant.

The compounds may be used as such for fungicidal purposes but are more conveniently formulated into compositions for such usage. The invention thus provides also a fungicidal composition comprising a compound of general formula (I) or a salt or complex thereof as hereinbefore defined, and a carrier or diluent.

The invention also provides a method of combating fungal diseases in a plant, which method comprises applying to the plant, to seed of the plant or to the locus of the plant or seed a compound or a salt or complex thereof as hereinbefore defined.

The compounds, salts and complexes can be applied in a number of ways, for example they can be formulated or unformulated, directly to the foliage of a plant, to seeds or to other medium in which plants are growing or

are to be planted, or they can be sprayed on, dusted on or applied as a cream or paste formulation, or they can be applied as a vapour. Application can be to any part of the plant, bush or tree, for example to the foliage, stems, branches or roots, or to soil surrounding the roots, or to the seed before it is planted.

The term "plant" as used herein includes seedlings, bushes and trees. Furthermore, the fungicidal method of the invention includes preventative, protectant, prophylactic and eradicant treatment.

The compounds are preferably used for agricultural and horticultural purposes in the form of a composition. The type of composition used in any instance will depend upon the particular purpose envisaged.

The compositions may be in the form of dusting powders or granules comprising the active ingredient and a solid diluent or carrier, for example fillers such as kaolin, bentonite, kieselguhr, dolomite, calcium carbonate, talc, powdered magnesia, Fuller's earth, gypsum, Hewitt's earth, diatomaceous earth and China clay. Such granules can be preformed granules suitable for application to the soil without further treatment. These granules can be made either by impregnating pellets of filler with the active ingredient or by pelleting a mixture of the active ingredient and powdered filler. Compositions for dressing seed, for example, may comprise an agent (for example a mineral oil) for assisting the adhesion of the composition to the seed; alternatively the active ingredient can be formulated for seed dressing purposes using an organic solvent (for example N-methylpyrrolidone or dimethylformamide).

The compositions may also be in the form of dispersible powders, granules or grains comprising a wetting agent to facilitate the dispersion in liquids of the powder or grains which may contain also fillers and suspending agents.

The aqueous dispersions or emulsions may be prepared by dissolving the active ingredient(s) in an organic solvent optionally containing wetting, dispersing or emulsifying agent(s) and then adding the mixture to water which may also contain wetting, dispersing or emulsifying agent(s). Suitable organic solvents are ethylene dichloride, isopropyl alcohol, propylene glycol, diacetone alcohol, toluene, kerosene, methylnaphthalene, the xylenes, trichloroethylene, furfuryl alcohol, tetrahydrofurfuryl alcohol, and glycol ethers (e.g. 2-ethoxyethanol and 2-butoxyethanol).

The compositions to be used as sprays may also be in the form of aerosols wherein the formulation is held in a container under pressure in the presence of a propellant, e.g. fluorotrichloromethane or dichlorodifluoromethane.

The compounds can be mixed in the dry state with a pyrotechnic mixture to form a composition suitable for generating in enclosed spaces a smoke containing the compounds.

Alternatively, the compounds may be used in a microencapsulated form.

By including suitable additives, for example additives for improving the distribution, adhesive power and resistance to rain on treated surfaces, the different compositions can be better adapted for various utilities.

The compounds can be used as mixtures with fertilisers (e.g. nitrogen-, potassium- or phosphorus-containing fertilisers). Compositions comprising only granules of fertiliser incorporating, for example coated with, the compound, are preferred. Such granules suitably contain up to 25% by weight of the compound. The invention therefore also provides a fertiliser composition comprising the compound of general formula (I) or a salt or metal complex thereof.

The compositions may also be in the form of liquid preparations for use as dips or sprays which are generally

aqueous dispersions or emulsions containing the active ingredient in the presence of one or more surfactants e.g. wetting agent(s), dispersing agent(s), emulsifying agent(s) or suspending agent(s). These agents can be cationic, anionic or non-ionic agents. Suitable cationic agents are quaternary ammonium compounds, for example cetyltrimethylammonium bromide.

Suitable anionic agents are soaps, salts of aliphatic monoesters of sulphuric acid (for example sodium lauryl sulphate), and salts of sulphonated aromatic compounds (for example sodium dodecylbenzenesulphonate, sodium, calcium or ammonium lignosulphonate, butylnaphthalene sulphonate, and a mixture of sodium diisopropyl- and triisopropyl-naphthalene sulphonates).

Suitable non-ionic agents are the condensation products of ethylene oxide with fatty alcohols such as oleyl or cetyl alcohol, or with alkyl phenols such as octyl- or nonyl-phenol and octylcresol. Other non-ionic agents are the partial esters derived from long chain fatty acids and hexitol anhydrides, the condensation products of the said partial esters with ethylene oxide, and the lecithins. Suitable suspending agents are hydrophilic colloids (for example polyvinylpyrrolidone and sodium carboxymethylcellulose), and the vegetable gums (for example gum acacia and gum tragacanth).

The compositions for use as aqueous dispersions or emulsions are generally supplied in the form of a concentrate containing a high proportion of the active ingredient(s), the concentrate to be diluted with water before use. These concentrates often should be able to withstand storage for prolonged periods and after such storage be capable of dilution with water in order to form aqueous preparations which remain homogeneous for a sufficient time to enable them to be applied by conventional spray equipment. The concentrates may conveniently contain up to 95%, suitably 10-85%, for example 25-60%,

by weight of the active ingredient(s). These concentrates suitably contain organic acids (e.g. alkaryl or aryl sulphonic acids such as xylenesulphonic acid or dodecylbenzenesulphonic acid) since the presence of such acids can increase the solubility of the active ingredient(s) in the polar solvents often used in the concentrates. The concentrates suitably contain also a high proportion of surfactants so that sufficiently stable emulsions in water can be obtained. After dilution to form aqueous preparations, such preparations may contain varying amounts of the active ingredient(s) depending upon the intended purpose, but an aqueous preparation containing 0.0005% or 0.01% to 10% by weight of active ingredient(s) may be used.

The compositions of this invention can comprise also other compound(s) having biological activity, e.g. compounds having similar or complementary fungicidal activity or compounds having plant growth regulating, herbicidal or insecticidal activity.

The other fungicidal compound can be for example one which is capable of combating ear diseases of cereals (e.g. wheat) such as Septoria, Gibberella and Helminthosporium spp., seed and soil borne diseases and downy and powdery mildews on grapes and powdery mildew and scab on apple etc. These mixtures of fungicides can have a broader spectrum of activity than the compound of general formula (I) alone; further the other fungicide can have a synergistic effect on the fungicidal activity of the compound of general formula (I). Examples of the other fungicidal compound are imazalil, benomyl, carbendazim, thiophanate-methyl, captafol, captan, sulphur, triforine, dodemorph, tridemorph, pyrazophos, furalaxyl, ethirimol, dimethirimol, bupirimate, chlorothalonil, vinclozolin, procymidone, iprodione, metalaxyl, forsetyl-aluminium, carboxin, oxycarboxin, fenarimol, nuarimol, fenfuram,

methfuroxan, nitrotal-isopropyl, triadimefon, thiabendazole, etridiazole, triadimenol, biloxazol, dithianon, binapacryl, quinomethionate, guazitine, dodine, fentin acetate, fentin hydroxide, dinocap, folpet, dichlofluanid, ditalimphos, kitazin, cycloheximide, dichlobutrazol, a dithiocarbamate, a copper compound, a mercury compound, DPX 3217, RH 2161, Chevron RE 20615, CGA 64250, CGA 64251 and RO 14-3169.

The compounds of general formula (I) can be mixed with soil, peat or other rooting media for the protection of plants against seed-borne, soil-borne or foliar fungal diseases.

Suitable insecticides are pirimor, croneton, dimethoate, metasystox and formothion.

Examples of suitable plant growth regulating compounds are the gibberellins (e.g. GA_3, GA_4 or GA_7), the auxins (e.g. indoleacetic acid, indolebutyric acid, naphthoxyacetic acid or naphthylacetic acid), the cytokinins (e.g. kinetin, diphenylurea, benzimidazole, benzyladenine or BAP), phenoxyacetic acids (e.g. 2,4-D or MCPA), substituted benzoic acids (e.g. TIBA), morphactins (e.g. chlorfluorecol), maleic hydrazide, glyphosate, glyphosine, long chain fatty alcohols and acids (e.g. Off Shoot O or Off Shoot T), dikegulac, Sustar, Embark, substituted quaternary ammonium and phosphonium compounds (e.g. CCC or Phosfon-D), Ethrel, carbetamide, Racuza, Alar, asulam, abscissic acid, isopyrimol, RH531, hydroxybenzonitriles (e.g. bromoxynil), Avenge, Suffix or Lontrel.

Dutch Patent Specification No. 7709197 discloses inter alia certain 2-(1,2,4-triazol-1-yl)-2-(optionally substituted benzyl)-1-alkyl-1-methylethanols and their use as plant fungicides. The compounds of general formula (I) have superior fungicidal activity to said compounds of the Dutch Patent Specification.

The following Examples illustrate the invention; the temperatures are given in degrees Centigrade (^{o}C).

EXAMPLE 1

1-(1,2,4-Triazol-1-yl)-2,3-diphenyl-propan-2-ol

Benzyl chloride (0.2 mol) was dissolved in dry diethyl ether (200 ml) and added dropwise to magnesium turnings (0.22 g atoms). After all the magnesium had reacted, the solution was refluxed for 1 hour and cooled to room temperature. Phenacyl chloride (0.1 mol) in dry diethyl ether (100 ml) was added dropwise over 1 hour at such a rate as to maintain gentle reflux. The solution was then refluxed for 2 hours, and cooled to room temperature; the mixture was poured into ice and the complex decomposed with ammonium chloride solution. The ethereal solution was washed several times with water (2 x 200 ml), dried (Na_2SO_4), and the solvent removed *in vacuo* to give, as a colourless oil, the crude chlorohydrin which was dissolved in dimethyl formamide (80 ml) and a solution of sodium triazole [prepared from sodium (0.1 g atoms) in methanol (40 ml) and 1,2,4-triazole (0.1 mol)] added dropwise at room temperature. After stirring at room temperature for 2 hours, the solution was warmed at 50° for 3 hours. The solvent was removed *in vacuo* and the residue poured into water to give a crystalline solid which was recrystallised from ethanol/petroleum ether to give the title compound, m.p. 124.5°.

EXAMPLE 2

1-(1,2,4-Triazol-1-yl)-2-phenyl-3-p-fluorophenyl-propan-2-ol

p-Fluorobenzyl chloride (0.1 mol) in dry diethyl ether (100 ml) was added dropwise to magnesium turnings (0.11 g atoms) and the solution stirred vigorously until refluxing occurred. When all the magnesium had reacted, the solution was refluxed for a further 1 hour and then cooled to room temperature. Phenacyl chloride (0.05 mol) in dry diethyl ether (50 ml) was added dropwise to the solution over 1 hour at such a rate as to maintain gentle reflux. The mixture was refluxed for 2 hours, cooled to room temperature and the mixture poured into ice/ammonium chloride solution to decompose the complex. The ethereal solution was washed several times with water (2 x 200 ml), dried (Na_2SO_4), and the solvent removed *in vacuo* to give, as a colourless oil, the crude chlorohydrin. The latter was dissolved in dimethylformamide (40 ml) and a solution of sodium triazole [prepared from sodium (0.05 g atoms) in methanol (20 ml) and 1,2,4-triazole (0.05 mol)] added dropwise at room temperature. After stirring at room temperature for 2 hours, the solution was warmed at 50° for 3 hours. The solvent was removed *in vacuo* and the mixture poured into water to give a crystalline solid which was recrystallised from petroleum ether/chloroform to give the title compound, m.p. 116-8°.

EXAMPLE 3

1,1-Diphenyl-2-(1,2,4)-triazol-1-yl-ethan-1-ol
(Compound 17)

Stage 1. Bromobenzene (0.2 mol, 31.4 g) in sodium dry diethyl ether (200 ml) was added dropwise to magnesium (0.22 gram atoms, 5.3 g). After all the magnesium had reacted, phenacyl chloride (0.1 mol, 15.5 g) in diethyl ether (100 ml) was added dropwise and the solution stirred at room temperature for 1 hour. The reaction mixture was poured into saturated ammonium chloride solution, washed with water (3 x 150 ml), and dried (Na_2SO_4). Removal of the ether gave a pale yellow oil which solidified on standing. Recrystallisation from petroleum ether (60-80°) gave 1,1-diphenyl-2-chloro-ethan-1-ol (60%) as a white crystalline solid, m.p. 56-57°.

Stage 2. 1,2,4-Triazole (0.03 mol, 2.07 g) was added portionwise to a suspension of sodium hydride (0.03 mol, 0.72 g) in DMF (30 ml) and the solution stirred until effervescence ceased. 1,1-Diphenyl-2-chloro-ethan-1-ol (0.015 mol, 2.94g) in dimethylformamide (DMF; 10 ml) was added dropwise and the solution warmed at 100° for six hours. The reaction mixture was poured into water and a white solid crystallised out. This was filtered off, washed with water, dried, and recrystallised from ethanol to give the title compound as a white crystalline solid, m.p. 128-129°.

EXAMPLE 4

2-Methyl-4-phenyl-5-triazol-1-yl-pentan-4-ol
(Compound 31)

Stage 1. The Grignard reagent generated from isobutyl bromide (0.1 mol, 13.7 g) in sodium dry diethyl ether (50 ml) and magnesium turnings (0.11 g atoms; 2.6 g) was added dropwise to a solution of phenacyl chloride (0.05 mol, 7.7 g) in sodium dry diethyl ether (100 ml) so that gentle reflux was maintained. The solution was then stirred at room temperature for 1 hour and the magnesium complex destroyed by pouring into a saturated ammonium chloride solution (200 ml). The ethereal extract was washed with water (3 x 150 ml) and dried (Na_2SO_4). Removal of the solvent gave a colourless liquid which distilled at reduced pressure to give 2-methyl-4-phenyl-5-chloro-pentan-4-ol (70%), b.p. 86-88°/0.01 mm Hg.

Stage 2. 1,2,4-Triazole (0.03 mol, 2.07 g) was added portionwise to 100% sodium hydride (0.03 mol, 0.72 g) in dry DMF (30 ml) and stirred at room temperature until the effervescence ceased. 2-Methyl-4-phenyl-5-chloro-pentan-4-ol (0.01 mol, 2.1 g) in dry DMF (10 ml) was added dropwise at room temperature and then the solution was stirred at 100° for 6 hours. On cooling to room temperature the solution was poured into water to precipitate out a solid which was recrystallised from petroleum (60-80°)/chloroform giving the title compound (60%) as a white crystalline solid, m.p. 94-95°.

EXAMPLE 5

1-(1,2,4-Triazol-1-yl)-2-o-chlorophenyl-2-p-fluorophenyl-ethan-2-ol (Compound 45)

A solution of dimethyl oxosulphonium methylide was prepared under nitrogen from sodium hydride (0.03 mol) and powdered trimethyl oxosulphonium iodide (0.03 mol) in dry dimethylsulphoxide (DMSO; 30 ml). A solution of o-chlorophenyl p-fluorophenyl ketone (0.025 mol) in DMSO (10 ml) was added dropwise at room temperature. The solution was then heated at 50° for 1½ hours, cooled to room temperature and poured into water. The solution was extracted with diethyl ether (100 ml), washed with water (3 x 100 ml), and dried over anhydrous sodium sulphate. Removal of the solvent gave 1-o-chlorophenyl-1-p-fluorophenyl ethylene oxide (90%) as a colourless liquid.

1,2,4-Triazole (0.04 mol) was added portionwise to sodium hydride (0.04 mol) in DMF (40 ml) and the solution stirred at room temperature until effervescence ceased. 1-o-Chlorophenyl-1-p-fluorophenyl ethylene oxide (0.02 mol) in DMF (10 ml) was added dropwise and the solution stirred at 80° for 4 hours. The solution was poured into water and triturated with petroleum ether to give a white crystalline solid which was filtered off and dried. Recrystallisation from petroleum ether (60-80°)/methylene chloride gave the title compound (70%) as a white crystalline solid, m.p. 115-116°.

EXAMPLE 6

The compounds were tested against a variety of foliar fungal diseases of plants. The technique employed was as follows.

The plants were grown in John Innes Potting Compost (No 1 or 2) in 4 cm diameter minipots. A layer of fine sand was placed at the bottom of the pots containing the dicotyledonous plants to facilitate uptake of test compound by the roots. The test compounds were formulated either by bead milling with aqueous Dispersol T or as a solution in acetone or acetone/ethanol which was diluted to the required concentration immediately before use. For the foliage diseases, suspensions (100 ppm active ingredient) were sprayed on to the soil. Exceptions to this were the tests on Botrytis cinerea, Plasmopara viticola and Venturia inaequalis. The sprays were applied to maximum retention and the root drenches to a final concentration equivalent to approximately 40 ppm a.i./ dry soil. Tween 20, to give a final concentration of 0.05%, was added when the sprays were applied to cereals.

For most of the tests the compound was applied to the soil (roots) and to the foliage (by spraying) one or two days before the plant was inoculated with the diseases. An exception was the test on Erysiphe graminis in which the plants were inoculated 24 hours before treatment. After inoculation, the plants were put into an appropriate environment to allow infection to take place and then incubated until the disease was ready for assessment. The period between inoculation and assessment varied from four to fourteen days according to the disease and environment.

The disease control was recorded by the following grading:-

4 = no disease
3 = trace - 5% of disease on untreated plants
2 = 6-25% of disease on untreated plants
1 = 26-59% of disease on untreated plants
0 = 60-100% of disease on untreated plants

The results are shown in Table II.

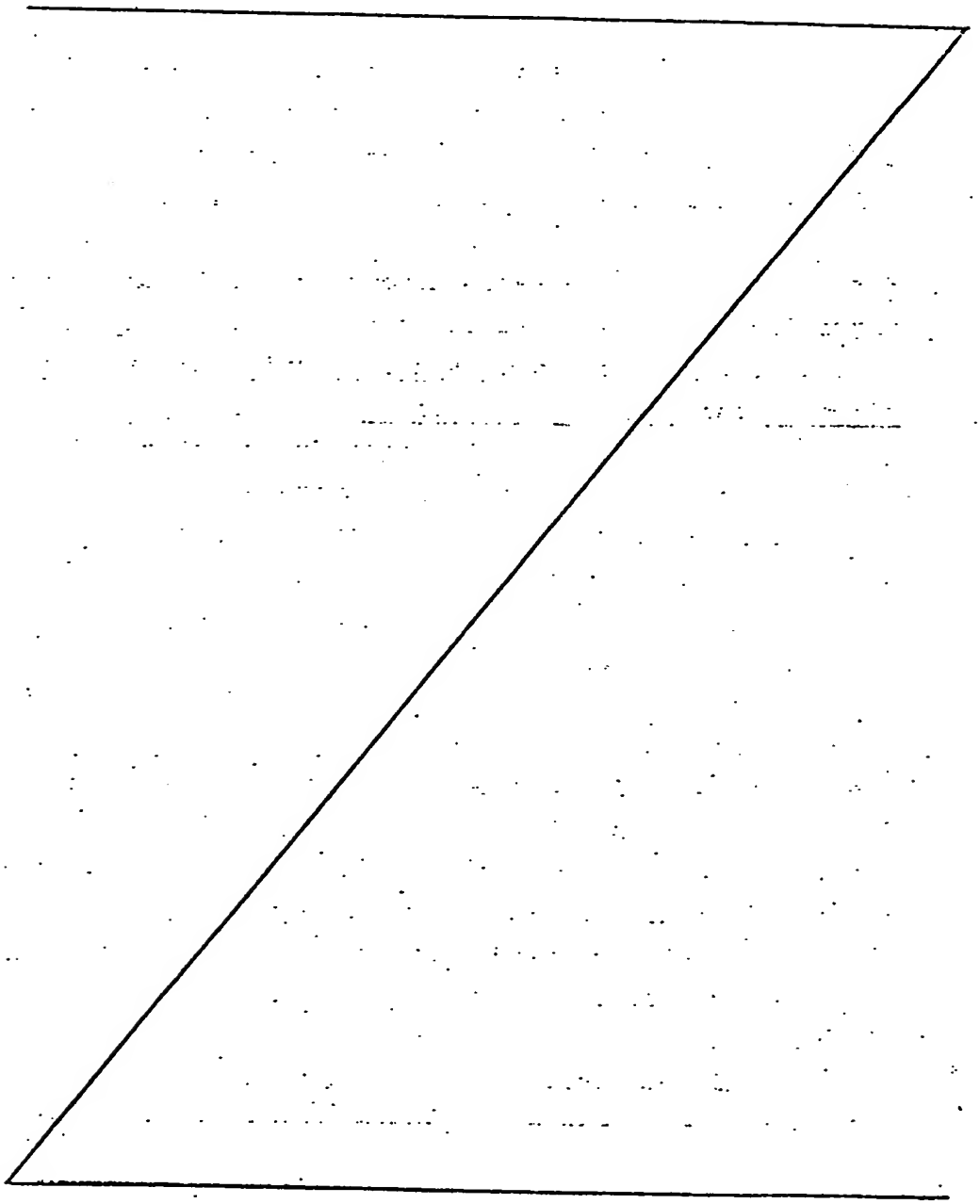


TABLE II

COMPOUND NUMBER	PUCCINIA RECONDITA (WHEAT)	ERYSIPHE GRAMINIS (BARLEY)	PIRICULARIA ORYZAE (RICE)	PLASMOPARA VITICOLA (VINE)	PHYTOPHTHORA INFESTANS (TOMATO)	BOTRYTIS CINEREA (TOMATO)	CERCOSPORA ARACHIDICOLA (PEANUT)	VENTURIA INEQUALIS (APPLE)
1	4	4	1	0	0	3	4	3
2	4	4	0	0	0	3	3	
3	4	4	1	0	0	3	4	1
4	3	4	0	4	0	3	4	1
5	4	4	1	4	0	3	3	4
6	4	4	3	2	0	3	4	
7	4		0	0	3	3	4	3
8	4		3	4	3	3	4	1
9	3	4	2	0	0	2	3	3
10	4	4	3	0		3	4	4
11	4	4	3	0	1	4	4	4

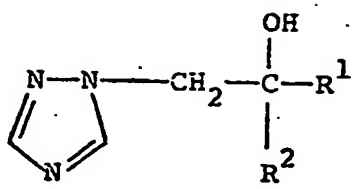
TABLE II

COMPOUND NUMBER	PUCCINIA RECONDITA (WHEAT)	ERYSIPHE GRAMINIS (BARLEY)	PIRICULARIA ORYZAE (RICE)	PLASMOPARA VITICOLA (VINE)	PHYTOPHTHORA INFESTANS (TOMATO)	BOTRYTIS CINEREA (TOMATO)	CERCOSPORA ARACHIDICOLA (PEANUT)	VENTURIA INEQUALIS (APPLE)
12	4	4		0	0	4	4	4
13	4	4	3	3	0	3	4	3
14	4	4	1	0	1	4	4	1
15	4	4	1	0	2	3	4	3
16	4	4	4	0	0	3	4	0
17		4		0	0	1	4	4
18	4		3	0	0	3	4	3
19	4	4	3	3	0		4	4
20	4	4	4	0	0	3	4	3
21	4	4	3	1	0	4	4	4
22	4	4	4	0	2	3	4	4

TABLE II

COMPOUND NUMBER	PUCCINIA RECONDITA (WHEAT)	ERYSIPHE GRAMINIS (BARLEY)	PIRICULARIA ORYZAE (RICE)	PLASMOPARA VITICOLA (VINE)	PHYTOPHTHORA INFESTANS (TOMATO)	BOTRYTIS CINEREA (TOMATO)	CERCOSPORA ARACHIDICOLA (PEANUT)	VENTURIA INEQUALIS (APPLE)
23	4	4	3	0	0	3	4	4
24		4	3	2	0	0	0	2
25	4	4	2	0	0	3	4	4
26	3	4	2	4	0	3	4	4
27	4	4	3	1	0	4	4	4
28	4	4	2	0	0	4		
29		4	3	0	0	3	4	4
30		4	3	0	0	3	4	4
31	4	4	2	0	0	0	3	4
32	3	4	0		0	2	4	4

1. A compound of general formula (I)



wherein R^1 is alkyl, cycloalkyl or optionally substituted phenyl and R^2 is optionally substituted phenyl or optionally substituted benzyl; or an acid addition salt or metal complex thereof.

2. A compound according to claim 1 characterised in that the phenyl or the phenyl moiety of the benzyl is optionally substituted with halogen, C_{1-5} alkyl, C_{1-4} alkoxy, trifluoromethyl, nitro, phenyl or phenoxy.

3. A compound according to claim 2 characterised in that R^1 is C_{1-4} alkyl and R^2 is optionally substituted benzyl.

4. A compound according to claim 2 characterised in that R^1 is optionally substituted phenyl and R^2 is optionally substituted benzyl.

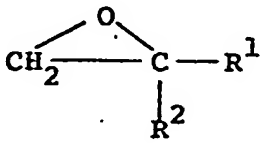
5. A compound according to claim 2 characterised in that each of R^1 and R^2, which may be the same or different, is optionally substituted phenyl.

6. A compound according to claim 2 characterised in that R^1 is C_{1-4} alkyl and R^2 is optionally substituted phenyl.

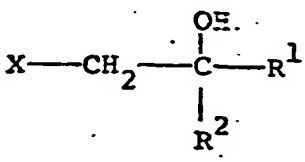
7. A compound according to any one of claims 1 to 3 and 6 characterised in that R^1 is butyl, e.g. t-butyl.

8. A compound according to claim 1 characterised by being 1-(1,2,4-triazol-1-yl)-2-phenyl-2-(p-chlorophenyl) propan-2-ol, 1-(1,2,4-triazol-1-yl)-2-phenyl-2-(p-fluorophenyl) propan-2-ol, 1-(1,2,4-triazol-1-yl)-2-phenyl-2-(2,4-dichlorophenyl) propan-2-ol, 1-(1,2,4-triazol-1-yl)-2,2-di(p-fluorophenyl)propan-2-ol, 1-(1,2,4-triazol-1-yl)-2-(p-chlorophenyl)-2-(o-fluorophenyl)propan-2-ol, 1-(1,2,4-triazol-1-yl)-2-phenyl-2-(2,4-dichlorophenyl) propan-2-ol in the form of crystals also containing within their crystal lattices 1 mole of ethanol, 1-(1,2,4-triazol-1-yl)-2-(o-chlorobenzyl)-3,3-dimethylbutan-2-ol, 2-(1,2,4-triazol-1-yl)-1-phenyl-1-(p-chlorophenyl) ethanol-1-ol.

9. A process for preparing a compound, salt or metal complex according to any one of the preceding claims, characterised by comprising reacting a compound of general formula (II) or (III)



(II)



(III)

wherein R^1 and R^2 are as defined in claim 1 and X is halogen, with 1,2,4-triazole in the presence of an acid binding agent or with an alkali metal salt of 1,2,4-triazole in a convenient solvent.

10. A fungicidal composition characterised by comprising a compound, salt or complex according to any one of claims 1 to 8, and a carrier or diluent.

11. A method of combatting fungal diseases in a plant, which method comprises applying to the plant, to seed of the plant or to the locus of the plant or seed a compound, salt or complex according to any one of claims 1 to 8.

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0015756
EP 80 30 0693

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 1 529 818 (I.C.I.) * Claims *	1-3, 10,11
	US - A - 3 394 143 (M. WOLFF) * Patent *	9
E	EP - A - 0 011 769 (BAYER) * Claims *	1,5,8, 9

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

C 07 D 249/08
A 01 N 43/64//
(C 07 D 303/28
C 07 C 31/34
29/40)

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

C 07 D 249/08

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26-06-1980	CREMERS

EPO Form 1503.1 06.78